Stratified Flow Facility

Studying density stratified flows in a controlled environment

A wide variety of interesting fluid dynamical phenomena are observed to occur in stably stratified flows. Numerous practical examples are to be found in the earth's atmosphere, whose density decreases exponentially with height, or the upper layers of the oceans, where temperature falls off rapidly from the warm surface layers to the much colder water found at greater depths. In order to study such flows in a controlled laboratory environment, the LLNL Stratified Flow Facility was designed.

Description

The Stratified Flow Facility (SFF) is a thermally stratified wind tunnel capable of generating temperature stratified flows with a controllable and highly repeatable vertical profile. The wind tunnel is of an open circuit configuration. A variable-pitch fan at the downstream end draws air through an upstream heat exchanger, which consists of a stack of triangular brass plates aligned with the flow. These plates are intersected by an array of 200 electrical heater rods (500 W each) that are driven by 10 independently adjustable controllers. Air passing through the heat exchanger acquires more heat at the top than at the bottom, thereby generating the desired stratified flow profile.

APPLICATIONS

- *Modeling stratification of ocean or atmosphere*

Following the heat exchanger is a turbulence management section, consisting of screens and honeycombs to reduce the turbulent fluctuation level; a 4:1 area ratio contraction; and the test section, which measures 0.61 meters (vertical) by 1.22 meters (transverse) by 2.44 meters (streamwise), with all walls transparent for flow visualization. The overall length of the facility is 19.8 meters.

The range of velocities that can be generated is from 1 to 12 m/s. The mean profile uniformity is within 1% across the span of the test section, and the turbulence level is everywhere less than 0.5%. Linear temperature gradients of more than 100°C/m can be generated with a spanwise uniformity of less than 0.2°C and a fluctuation level less than 0.2°C.

Meaurements

The test section has been instrumented with a three-axis, computer-controlled traversing system. Hot-wire anemometers and cold-wire resistive thermometers are used to make quantitative measurements of the velocity and temperature fields, respectively. They are mounted on a two-axis traverse that covers the full width and height of the test section at a fixed, but adjustable, streamwise location. Models under investigation are positioned with the third traverse, which moves in the streamwise direction, thus allowing a full three-dimensional volume behind the model to be investigated.

Availability: The Center is available now for modeling collaborations.

Contact

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